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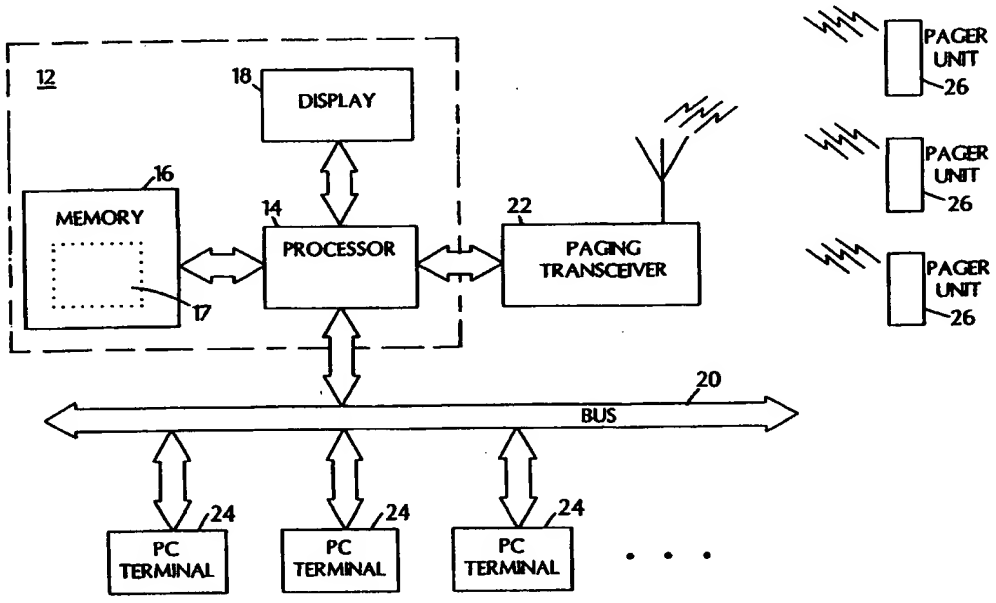

(57) Abstract

A local-area paging system (10) operates in a full-duplex mode of operation and includes a paging station (12, 22) which transmits a paging message and a remote transponder (26) which, in operation, acknowledges receipt of the paging message by transmitting another paging message including at least a portion of the original paging message to the paging station. The remote transponder, in response to receiving a locating paging signal transmitted from a broadcasting paging station, automatically acknowledges receipt of the locating paging signal by transmitting an acknowledgement signal to the paging station.

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LOCAL-AREA PAGING SYSTEM

Background of the Invention

The invention relates to paging systems.

Paging systems, whether on-site, city-wide, regional or nationwide, utilize radio transmitters which broadcast a stream of messages on a specific radio frequency channel. Special receivers, called pagers, are tuned to the specific channel and constantly listen to the message stream, waiting for messages intended for their special address (called a cap code or pager ID number). One of the more popular types of pagers is the digital display or numeric pager. With this type of pager, a caller enters a callback number through a standard telephone keypad and that number is displayed on the subscriber's pagers. Most current models include a limited storage capacity for received messages, and many offer silent vibration alerting mechanisms in addition to standard audible mechanisms.

Many paging systems require licensed use from the Federal Communications Commission (FCC). The relatively high costs associated with licensed use of the FCC channels are generally passed on to the consumer in the form of monthly charges.

In general, on-site paging systems work similarly to regional or nationwide paging systems. However, because an on-site paging system is intended to be used within a localized area (e.g., an office building, hospital), its transmission range is generally far less than regional or nationwide paging systems. The limited transmission range of a local paging system provides certain advantages not attainable by wider range systems. For example, because the local paging system is owned by the user, management is local, use is unlimited and typically there are no airtime charges. Transmission time is also generally much faster (e.g., less than 8

seconds). To extend the range of coverage, certain on-site paging systems also sub-license use of FCC-licensed spectrum from licensors operating wider range paging systems.

Summary of the Invention

In one aspect of the invention, a local-area paging system includes a paging station and a remote transponder which, in operation, acknowledges receipt of a paging message by transmitting a response message back to the paging station including at least a portion of the paging message (e.g., the electronic serial number or data message) transmitted by the paging station. Related aspects of the invention include the remote transponder itself and a method of establishing two-way communication using the paging system described above.

Among other advantages, by requiring the remote transponder to transmit back at least a portion of the paging message sent by the paging station, the user can be assured that not only was the paging message received, but the actual content of the paging message was successfully received. Thus, the system and method of use operating the system provides reliable communication channels for transmitting and receiving paging and response messages. Moreover, because the power levels used to transmit signals with the local-area paging system are less than levels requiring FCC licensing, high reliability can still be achieved at relatively low cost.

In another aspect of the invention, a local-area paging system features full-duplex, two-channel communication between portable remote transponders and a paging station. Full-duplex communication allows both the paging station and the remote transponder to receive and transmit signals simultaneously. For example, the remote transponder can begin transmitting an acknowledgement message, while receiving the paging

message from the paging station. Thus, the speed and efficiency in transmitting and receiving signals can be increased significantly.

Embodiments of the above aspects of the invention may include one or more of the following features. The paging message transmitted by the paging station includes a response data field which indicates to the remote transponder the portion of the paging message (or all of it) to be included in the response message sent back to the paging station to acknowledge receipt. For example, the portion of the paging message sent by the paging station includes an electronic serial number associated with the remote transponder or, alternatively, the data message itself.

The paging station includes a transceiver which transmits the paging message in a frequency range different from a frequency range used by the paging station to receive the response message sent by the transponder. Thus, the paging station and remote transponder both use separate and independent channels to transmit and receive signals between them, thereby further increasing the reliability in the transmission and reception of messages. Also, as will be discussed in greater detail below, using different frequency ranges allows full-duplex operation of the local-area paging system.

The local-area paging system includes a communications bus and the paging station includes a paging controller connected to the paging station via the communications bus. The controller includes an input device (e.g., keyboard, mouse) for initiating the transmission of the paging message sent by the paging station. In one application, the controller is configured to receive an electronic data message (e-mail), construct a paging message to include the

electronic data message, and transmit the paging message to the remote transponder.

In applications requiring extended transmission range, one or more remote transceivers are connected to the paging controller via a power line (e.g., AC wiring). In operation, the remote transceiver, receives and transmits paging signals to and from the paging controller through the power line, and transmits and receives response signals to and from the remote transponder. Thus, the transmission range of the paging station is effectively extended, and transmission to remote but isolated areas can be accomplished, without increasing the transmission power level of the paging station and implicating FCC licensing regulations.

In still another aspect of the invention, the local-area paging system includes a remote transponder which, in response to receiving a locating paging signal transmitted from a broadcasting paging station, automatically acknowledges receipt of the locating paging signal by transmitting an acknowledgement signal to the paging station.

Embodiments of this aspect of the invention may include any of the features discussed above, as well as the following additional features. The paging station broadcasts the locating paging signal in response to an operator request or, alternatively, programmed to broadcast automatically on a periodic basis (e.g., every two minutes). Thus, at any given time, the availability of a particular or all transponder carriers can be determined.

All of the above aspects provide substantial advantages in a wide variety of environments including office, hospital, industrial and manufacturing settings and for a wide variety of applications.

Other features and advantages will become apparent from the following description and from the claims.

Brief Description of the Drawings

Fig. 1 is a block diagram of the local-area paging system of the present invention.

Fig. 2 is a block diagram of the RF transceiver of the local-area paging system of Fig. 1.

Fig. 3 is a block diagram of the remote transponder of the local-area paging system of Fig. 1.

Fig. 4 is a perspective view of the remote transponder of Fig. 3.

Fig. 5 is an example of a display screen of the operator interface for the paging controller of Fig. 1.

Fig. 6 is another example of a display screen of the operator interface for the paging controller of Fig. 1.

Fig. 7 is an alternative embodiment of a display screen of the operator interface.

Fig. 8 is an example of a display screen associated with the operator interface of Fig. 7.

Fig. 9 is an example of another display screen associated with the operator interface of Fig. 7.

Fig. 10 is a flow diagram for the operation of the local-area paging system.

Fig. 11 is a flow diagram for the operation of the local-area paging system.

Fig. 12 is a block diagram of another embodiment of the local-area paging system of the present invention.

Description

Referring to Fig. 1, a local-area paging system 10 for providing wireless communication within a limited range, such as an office building or hospital, is shown. Paging system 10 includes a paging controller 12 having a processor 14, a memory 16 for storing a system administrator program 17 for controlling paging system 10 and a display monitor 18. Paging controller 12 may be, for example, a Pentium-based personal computer for

controlling the sending and receiving of paging messages between the paging transceiver 22 and remote transponders 26. Paging controller 12 is connected via a bus 20 to a radio frequency (RF) transceiver 22 (transmitter-receiver) and desktop personal computer terminals 24 located throughout the building. Paging controller 12 and paging transceiver 22 together serve as paging station.

In response to control and data signals from paging controller 12, RF transceiver 22 sends paging signals which are received by remote transponders 26 registered by system 10 and assigned to carriers (e.g., employees).

Referring to Fig. 2, RF transceiver 22 includes a dual-band antenna 28 in the form of a flexible "rubber duck" antenna and a frequency diplexer 30 for separating signals received by antenna 28 in a receive frequency range around 49 MHz and signals transmitted from antenna in a transmit frequency range around 912 MHz. RF transceiver 22 also includes a receiver section 32 configured to receive signals from remote transponders 26 in the receive frequency range. Receiver section 32 includes a dual-conversion frequency modulation receive module 34 (e.g., Part No. MC3363, Motorola Semiconductor Inc., Phoenix, AZ) having a demodulator which separates the frequency modulated data from the carrier signal.

RF transceiver 22 includes a transmitter section 36 capable of delivering approximately between 2 and 3 watts of pulse modulated power in a frequency range between 902-928 MHz. Serial data from processor 14 is provided to transmitter section 36 at a data rate of 19.2 KB/sec. The data is amplitude-modulated and amplified using a pulse-modulated voltage controlled oscillator (VCO) 38 and a power amplifier section 40, respectively. Control circuitry 42 is connected to receiver section 32 and transmitter section 36 to properly synchronize and

lock the control signals needed to ensure proper operation of transceiver 22. In operation, transmitter section 36 is capable of broadcasting signals in an open field range of about 100 to 200 feet, depending on local conditions (e.g., building type).

Referring to Fig. 3, each remote transponder 26 is capable of full-duplex RF communication with RF transceiver 22. Remote transponder 26 includes a microprocessor 50 (e.g., Product No. M38203M4-116FP, Mitsubishi Electric) which controls the transmission of signals from a transmitter 52 and reception of signals from a receiver 54. A memory 56 stores an application program (discussed below) and a predefined set of data response messages which the user can step through by pressing switch 58. A back-lit, liquid crystal display (LCD) 60 communicates message information transmitted from transceiver 22 and the predefined set of data response messages stored in memory 56. LCD display 60 is in the form of a two-line alphanumeric display (Fig. 4).

Receiver 54 has a monoblock ceramic filter 64 tuned at 912 MHZ, an AM demodulator 66 and a logarithmic amplifier 68. Amplifier 68 of receiver 54 has a gain in a range between 80 and 100 dB and includes a Receive Signal Strength Indicator (RSSI) which provides a voltage signal proportional to the strength of the RF signal to processor 50. Processor 50 uses the voltage signal to determine whether the RF signal is of sufficient amplitude to elicit a response. In other embodiments, a receiver having a superheterodyne configuration could be used.

FM transmitter 52 (e.g., Part No. MC2833, Motorola Semiconductor Inc., Phoenix, AZ) transmits RF data signals at a power level of approximately 10 dBm (10 mwatts) and a frequency of 49.86 MHz at a data rate of 19.2 KB/sec. Transmitter 52 includes an oscillator circuit 70 which generates a signal having a frequency of

16.62 MHZ established by a crystal 72. The signal is tripled and amplified using a 3X frequency multiplier 74 and amplifier 76, respectively.

A monopole antenna 78 for transmitting and receiving signals to and from transceiver 22 has a radiation efficiency characteristic optimized for operation at 912 MHz. Thus, transponder 26 has a sensitivity characteristic for receiving signals from transceiver 22 at power levels as low as -50 dBm (.01 μwatts). Although antenna 78 has a relatively poor antenna gain at the frequency of transmission (49.6 MHz), the poor antenna gain characteristic is offset by the relatively high transmission power level (+10 dBm) of transponder 26 and the relatively high sensitivity of receiver 32 of transceiver 22.

Power supply circuitry 80 receives +6 volts from a battery pack 82 (four AA batteries) and generates power signals at appropriate signal levels for microprocessor 50, display 60, transmitter 52 and receiver 54. Transponder 26 also includes an audio alarm 84, such as a beeper, which is activated in response to receiving a paging signal from transceiver 22.

Referring to Fig. 4, remote transponder 26 includes a plastic housing 86 having dimensions of about 4.8" X 2.9" X 0.75" allowing it to be conveniently carried in a pocket or worn on the hip. In this embodiment, switch 58 of remote transponder is in the form of a pair of switches 58a, 58b to allow scrolling in opposite directions.

Upon initialization of local paging system 10, processor 14 executes system administrator program 17 stored in memory 16 of paging controller 12. System administrator program 17 provides several operator display screens which facilitate the selection of the desired functionality of paging system 10.

Referring to Fig. 5, an example of an operator display screen 90 of the operator interface is shown. Display screen 90 is a Windows-based presentation screen separated into a window title 92, menu bar 94 and operator interface window 96. Operator interface window 96 is divided into different sections for displaying operator-selectable options and control buttons which are selected using an input device, such as a mouse, trackball or keyboard.

Operator interface window 96 includes a users section 98 which lists the names of personnel or groups of personnel carrying remote transponders 26 within the broadcast range. Users section 98 includes a user selection bar 100 which indicates the person selected from users section 98 and a last status display area 102 which indicates the last status of the selected person from the users section. For example, as the operator scrolls through the list of names in users section 98, highlighting the selected name and indicating the selected persons status (e.g., UNKNOWN, IN RANGE, OUT OF ZONE).

A message section 106 lists a set of user-defined, pre-stored messages which can be transmitted to the selected person(s) from users section 98 who are being paged. A message selection bar 108 indicates the pre-stored message selected from message section 106. An options section 112 displays a list of options which are associated with particular ones of the set of user-defined messages listed in message section 106. For example, the operator can transmit the telephone extension number where the incoming phone call has been camped or parked.

In the particular example shown in Fig. 4, the operator has selected the name "Richard Harrison" from the list of persons in users section 98, has selected the

"CALL ON" option from message section 106 that there is a call being held on line "232" from options section 112.

Referring to Fig. 6, in another scenario, the operator has made the appropriate selections from users section 98, message section 106 and options section 112 requesting that Joe McConnell "GO TO" the "FRONT DESK". Certain ones of the messages may not have corresponding options listed in options section 112. For example, the message "VISITORS ARRIVED" impliedly indicates that there are visitors at the reception area.

Operator interface window 96 also includes a "SEND MESSAGE" bar 116 which is selected (e.g., "clicked") after making the appropriate selections from users section 98, message section 106 and options section 112. A status section 118 indicates whether the paging message with the selected information was successfully received by the remote transponder associated with the designated user. A task completion bar 120 provides immediate feedback and an ongoing indication of the completion percentage of the particular task being performed.

A scan section 122 allows the operator to send a locating or polling message to determine whether an individual transponder is in range by selecting button 124. Alternatively, all of the transponders associated with users listed in users section 98 can be polled by selecting button 126. In either case, receiving the locating message and transmitting an acknowledgement message by the remote transponder is performed without knowledge of the holder of the transponder. In certain applications, controlling pager 12 can scan on an ongoing basis or scan periodically to see which transponders are in range. The operator need only look to last status display area 102 to determine whether a particular transponder is in range. For example, in an office environment, controlling pager may scan the availability

of transponders every two minutes, whereas in a hotel environment scanning is performed less often.

Referring to Fig. 7, in another embodiment of the operator interface, an operator display screen 200 is presented on display 18 when system 10 is first initialized, when the operator is awaiting a response, or when the system is generally idle. Display screen 200 includes an image 202 of remote transponder 26 having a section 204 for displaying response messages received from remote transponder 26. Display screen 200 also includes a "Send Message" bar 206 which, when clicked, causes system administrator program 17 to display message selection screen 210 as shown in Fig. 8.

Referring to Fig. 8, message selection screen 210 is a Windows-based presentation screen which is divided into different sections for displaying operator-selectable options and control buttons. Message selection screen 210 includes an operator interface window 216 having a users section 218 which lists individual names or groups of names (collected within folders) of personnel carrying remote transponders 26 within the broadcast range. A message section 220 lists a set of user-defined, pre-stored messages (e.g., "*Call on Line One*", "*Visitors in Lobby*") which can be transmitted to the selected person(s) from users section 218 who are being paged. Message section 220 also allows the operator to type in a customized message for transmission by selecting, for example, *Msg2*, *Msg3*. Selecting one of the displayed messages causes an edit window (not shown) to "pop up" within operator interface window 216 within which the selected pre-stored message is displayed or to allow a customized message to be entered. A response section 222 displays the message transmitted back from remote transponder 26.

Message selection screen 210 also includes an "Advanced Options" button 224, a "Cancel" button 226, and

a "Send" button 228. Clicking "Cancel" button 226 causes all selections made to be cancelled so that new selections can be made. Clicking "Send" button 228 causes processor 14 to construct the data message based on the selections made and paging controller 12 to transmit the message.

Referring to Fig. 9, when "Advanced Options" button 224 is clicked, an advanced options window 230 is displayed. Advanced options window 230 allows the operator to select the manner in which persons within a group folder selected from users section 218 are paged. For example, the operator can choose to broadcast a message to all persons within the folder. Alternatively, the operator can broadcast the message in serial fashion so that only the first person named in the group is paged. After a predetermined duration of time is passed, and assuming no response is received by the first person, the message is retransmitted to the second person named in the group. The advanced options window 230 allows the amount of predetermined duration of time (e.g., 30 seconds, two minutes) to be varied as desired.

Advanced options window 230 also includes a Page Filter window 232 and a Page Triggers window 234. Page Filter window 232 displays types of messages preprogrammed by the holder of a particular remote transponder 26 to "filter" or selectively control the types of paging messages which will be transmitted. On the other hand, Page Triggers window 234 displays types of messages preprogrammed by the holder of a particular remote transponder 26 to "trigger" transmission of a message upon the occurrence of a particular event. A "Define Groups" window 236 allows the operator to add, remove or edit names of personnel carrying the remote transponders or add remove or edit names of personnel in user groups (folders).

Referring to Fig. 10, the format of a constructed data message 160 is shown. Each data message begins with a header 162 having a pair of synchronization bytes and ends with an end of field checksum byte 164. Header 162 synchronizes each transponder 26 that is receiving signals from transceiver 22. A series of control bytes including a transaction type field 166 (one byte), a transmit data field 168 (two bytes) and a response data field 170 (two bytes) follow header 162. The control bytes are followed by a data message 172 encoded using a Manchester encoding scheme. In applications where secured communication is required, data message 172 can be encrypted using any of variety of software encryption products.

Transaction type field 166 includes positionally encoded bits with control information. The encoded bits request, for example, whether the transponder will sound audible alarm 84 and/or whether the user is required to press switch 58. Transmit data field 168 includes positionally encoded bits which indicate that the electronic serial number (ESN) of the particular transponder(s) are being transmitted, that an LCD message is to be displayed and that response data from the transponder is expected to be returned. The response data field 170 includes positionally encoded bits which indicate the type of response data controlling pager 12 expects to receive in order to acknowledge that the transmitted message was successfully received by the transponder. Response data field may also request that a digital representation of the RSSI value be returned to controlling pager 12. Data message 172 is of variable length and includes one of the user-defined messages selected from message section 106 of operator interface window 96 or the personal message typed by the operator.

With reference to Fig. 11, the process for communicating with local-area paging system 10 is shown.

In response to the occurrence of an event (130), such as a phone call received by the operator (e.g., receptionist) stationed at paging controller 12, a user or user group is selected from users section 98 of operator interface window 96 (132). The operator then selects a predetermined one of the user-defined messages listed in message section 106 or, alternatively, can type a personal message (134). The operator then clicks the "SEND MESSAGE" bar 116 which causes processor 14 of paging controller 12 to construct the message to be transmitted (136). Before the actual data message is sent, a broadcast alert signal is first transmitted from paging transceiver 22 alerting all transponders within broadcast range that a data message is about to be sent (138). The broadcast alert signal is shown on display 18 and in status section 118 of operator interface window 96 in the form of the message "SET ALL UNITS TO LISTEN". The broadcast alert signal maximizes the possibility that the subsequently sent data message will be received by setting all transponders in "listen" mode.

The constructed data message is then transmitted by paging transceiver 22 to the selected transponder or group of transponders (140). The selected transponder receives the data message and acknowledges receipt of the message by sending a response message in accordance with response criteria sent in the data message (144). For example, the data message may include the ESN of each transponder being transmitted to. Alternatively, selected transponders may transmit back to paging controller 12, the Manchester encoded data message received by the selected transponder.

When the acknowledgement message is received by transceiver 22, it is passed to paging controller 12 where processor 14 compares the positionally encoded bits representing the ESN for the transmitted and received by transceiver 22. If the ESNs are the same, the

transmission is considered to be successful and paging controller 12 displays "MESSAGE RECEIVED" in status section 118 of operator interface window 96.

If controlling pager 12 does not receive any indication that the message was successfully received by the designated transponder 26 within a predetermined time period (e.g., 3 seconds), transceiver 22 is instructed to re-transmit the message. After a predetermined number of re-transmission attempts have been made (146), paging controller displays "MESSAGE NOT RECEIVED" in status section 118 on display 18 (148).

Referring to Fig. 12, in certain applications and environments, it may be desirable to extend the range of transmission and reception to a remote area 180 beyond the transmission and reception range of transceiver 22. In such applications and environments, a remote powerline communication controller 182 is connected to a serial port of paging controller 12 and is used to provide control and data signals to remote transceivers 184 connected to AC power lines 186 which extend from the area of paging controller 12 to remote area 180. A suitable powerline communication controller, Product No. SSC P400, is commercially available from Intellon Corporation, Ocala, FL. In operation, a powerline communication controller 182 provides control signals and paging messages from processor 14, through AC power lines 186 and to a remote transceiver 184 via its own powerline communication controller. Remote transceiver 184 transmits the paging message to remote transponders 26a in remote area 180. Similarly, acknowledgement and paging messages transmitted by remote transponder 26a are received through the airways by remote transceivers 184, passed to powerline communication controllers 182 and transmitted to paging controller 12 via AC power lines 186.

Although the range of the transceiver could be increased to extend transmission and reception to the remote area by increasing its output power or antenna gain, such approaches may implicate FCC regulations and/or cause transmission in unwanted areas, such as in areas between the original broadcast area and the remote area. For example, local paging system 10 may be configured to provide paging on the west end of the first floor of the office building. However, remote area 30 at the far east end of the floor may also require paging services.

Other embodiments are within the scope of the claims. For example, both paging controller 12 and remote transponder 26 can include an infrared emitter/detector interface which, in operation, allows data to be transferred between remote transponder 26 and other computer terminals connected to bus 20 or between transponder 26 and paging controller 12. This infrared data link can be used to download into memory 56 of transponder 26 often-used personal response messages, or important phone numbers.

In one embodiment, remote transponder 26 can also be programmed to allow the user to "filter" or selectively control the types of paging messages which sound audible alarm 84. In effect, the holder is able to prioritize or filter the types of disruptions he or she will respond to at a particular time. For example, the user may decide voicemail messages or e-mail messages will not trigger alarm 84, or that the alarm should only be sounded if expected visitors arrive. Even in this case, however, remote transponder 26 acknowledges receipt of the paging message by transmitting a message back to paging controller 12 with a predetermined response message (e.g., "TOO BUSY TO RESPOND"). Switch 56 is used to allow the holder at any time to change the priority of interruption events which trigger alarm 84.

Personal computer 24 can also be programmed to establish interruption priorities so that only certain types of interruption activities cause computer 24 to instruct paging controller 12 to construct and transmit a paging message. The program can be downloaded to remote transponder via the infrared emitter/detector interface described above.

Although local-area paging system 10 is described above in the context of an office environment, it should be appreciated that the system can be used advantageously in a wide variety of other settings and, depending upon the setting, the transmitting of paging signals can be triggered by different events.

For example, in a hospital environment, medical personnel carrying transponders can be located and alerted to incoming phone calls by a receptionist operator or secretary. On the other hand, personal computer terminal 24 associated with the personnel and connected to paging controller 12 via bus 20, can be programmed to initiate a paging message in response to an incoming facsimile, electronic mail or voice mail message. In a hospital setting, paging messages can also be initiated by medical monitoring instrumentation to alert the medical personnel that a patient requires assistance.

In an industrial setting, monitoring or security devices having sensors can be used to initiate a paging message to notify the maintenance or security person of a fault or break in security. In a financial investment application, personal computer 24 can be programmed to monitor market activity (e.g., over the Internet) and initiate an instruction to paging controller 12 and transmit a paging message when, for example, a stock price rises or drops to a certain level.

What is claimed is:

1. A local-area paging system comprising:

a paging station which, in operation, transmits a paging message; and

a remote transponder which, in operation, receives the paging message from the paging station and acknowledges receipt of the paging message by transmitting a response message to the paging station, the response message including at least a portion of the paging message.

2. The local-area paging system of claim 1 wherein the paging message includes a response data field which indicates to the remote transponder said at least portion of the paging message to be included in the response message.

3. The local-area paging system of claim 2 wherein said at least portion of the paging message includes an electronic serial number associated with the remote transponder.

4. The local-area paging system of claim 2 wherein said at least portion of the paging message includes a data message.

5. The local-area paging system of claim 1 wherein the paging station includes a transceiver which transmits the paging message in a first frequency range and receives the response message in a second frequency range different from the first frequency range.

6. The local-area paging system of claim 5 wherein the remote transponder receives the paging

message in the first frequency range and transmits the response message in the second frequency range.

7. The local-area paging system of claim 1 further comprising a communications bus and the paging station includes a paging controller connected to the paging station via the communications bus.

8. The local-area paging system of claim 7 wherein the paging controller includes an input device for initiating the transmission of the paging message.

9. The local-area paging system of claim 7 wherein the paging controller is configured to receive an electronic data message, construct the paging message to include the electronic data message, and transmit the paging message to the remote transponder.

10. The local-area paging system of claim 7 further comprising a computer terminal connected to the communications bus, the computer terminal and the remote transponder each having an infrared emitter/detector and, in operation, establishing an infrared data link to allow data to be transferred between the remote transponder and the computer terminal.

11. The local-area paging system of claim 1 further comprising a remote transceiver connected to the paging controller via a power line, the remote transceiver, in operation, receiving and transmitting the paging and response messages to and from the paging controller, respectively through the power line, the remote transceiver transmitting and receiving the paging and response messages to and from the remote transponder, respectively.

12. A local-area paging system comprising:

a paging station which, in operation, transmits a locating paging signal within a broadcast area; and

a remote transponder which, in response to receiving the locating paging signal transmitted from the paging station, automatically acknowledges receipt of the locating paging signal by transmitting an acknowledgement signal to the paging station.

13. The local-area paging system of claim 12 wherein the locating paging signal includes positionally encoded bits which indicate to the remote transponder requested information to be included in the acknowledgement signal.

14. The local-area paging system of claim 13 wherein the positionally encoded bits include an electronic serial number associated with the remote transponder.

15. The local-area paging system of claim 12 wherein the paging station broadcasts the locating paging signal in response to an operator request.

16. The local-area paging system of claim 12 wherein the paging station automatically broadcasts the locating paging signal on a periodic basis.

17. A two-way transponder for communicating with a remotely located paging station which, in operation, transmits a paging message having information content, the two-way transponder comprising:

a receiver which receives the paging message from the paging station and; which receives a paging message from a remotely located paging station, the paging message; and

a transmitter which acknowledges receipt of the paging message by transmitting a response message to the paging station, the response message having the information content of the paging message.

18. The two-way transponder of claim 17 wherein the paging message includes a response data field which indicates to the remote transponder said at least portion of the paging message to be included in the response message.

19. The two-way transponder of claim 17 wherein said at least portion of the paging message includes an electronic serial number associated with the remote transponder.

20. The two-way transponder of claim 17 wherein the receiver receives the paging message in a first frequency range and transmits the response message in a second frequency range different from the first frequency range.

21. The two-way transponder of claim 17 further comprising an infrared emitter/detector which, in operation, transmits and receives data to and from an infrared data link.

22. A local-area paging system comprising:

a paging station which, in response to an operator selection, transmits a paging message in a first frequency range; and

a remote transponder which, in full duplex operation, and in response to receiving the paging message from the paging station, transmits a response message at a second frequency, different from the first frequency range to the paging station, thereby acknowledging receipt of the paging message.

23. A method of establishing two-way communication between a paging station and a remote transponder comprising:

transmitting from the paging station a paging message to the remote transponder;

the remote transponder acknowledging receipt of the paging message by transmitting a response message including at least a portion of the paging station to the paging station; and

the paging station, confirming receipt of the paging message by the remote transponder, by comparing said at least portion of the response message transmitted by the remote transponder with the said at least portion of the paging message transmitted by the paging station.

24. The method of claim 23 wherein transmitting from the paging station includes he step of constructing the paging message to have a response data field which indicates to the remote transponder said at least portion of the paging message to be included in the response message.

25. The method of claim 24 wherein the constructing step includes providing an electronic serial

number associated with the remote transponder as part of the paging message.

26. The method of claim 24 wherein the constructing step includes providing a data message as part of the paging message.

27. The method of claim 23 wherein transmitting from the paging station includes transmitting the paging message in a first frequency range and transmitting from the remote transponder includes transmitting the response message in a second frequency range different from the first frequency range.

28. A local area paging system comprising:

a paging station configured to receive a notification of a received message provided by a source external to the local area paging system, the paging station, in response to receiving the notification, configured to construct and transmit a paging message; and

a remote transponder which, in operation, receives the paging message from the paging station.

29. The local-area paging system of claim 28 wherein the received message is a telecommunication message.

30. The local-area paging system of claim 29 wherein the telecommunication message is an electronic data message.

31. The local-area paging system of claim 29 wherein the telecommunication message is an incoming facsimile.

32. The local-area paging system of claim 29 wherein the telecommunication message is a telephone message.

33. The local-area paging system of claim 29 wherein the telecommunication message is a message from a wide-area paging system.

34. The local-area paging system of claim 29 wherein the telecommunication message is a voicemail message.

35. The local-area paging system of claim 28 wherein the notification includes at least a portion of the received message and the paging controller, upon receiving the notification, constructs the paging message including at least a portion of the received message, and transmits the paging message to the remote transponder.

36. The local-area paging system of claim 28 further comprising a communications bus and the paging station includes a paging controller configured to receive the notification over the communications bus.

37. A method of using a local area paging system to page a user, the local area paging system including a paging station and a remote transponder associated with the user, the method comprising:

receiving a message sent from a source external to the local area paging system, the message intended for receipt by the user;

transmitting to the paging station, notification that the message from the external source has been received;

constructing and transmitting, by the paging station, a paging message; and

receiving, by the remote transponder, the paging message transmitted by the paging station.

38. The method of claim 37 wherein receiving the message from an external source includes receiving a telecommunication message.

39. The method of claim 38 wherein the telecommunication message is an electronic data message.

40. The method of claim 38 wherein the telecommunication message is an incoming facsimile.

41. The method of claim 38 wherein the telecommunication message is a telephone message.

42. The method of claim 38 wherein the telecommunication message is a message from a wide-area paging system.

43. The method of claim 38 wherein the telecommunication message is a voicemail message.

44. The method of claim 37 further comprising transmitting the notification over a communications bus connecting the paging station and a receiver of the message sent from the external source.

45. The method of claim 37 further comprising including at least a portion of the message sent from the external source within the paging message.

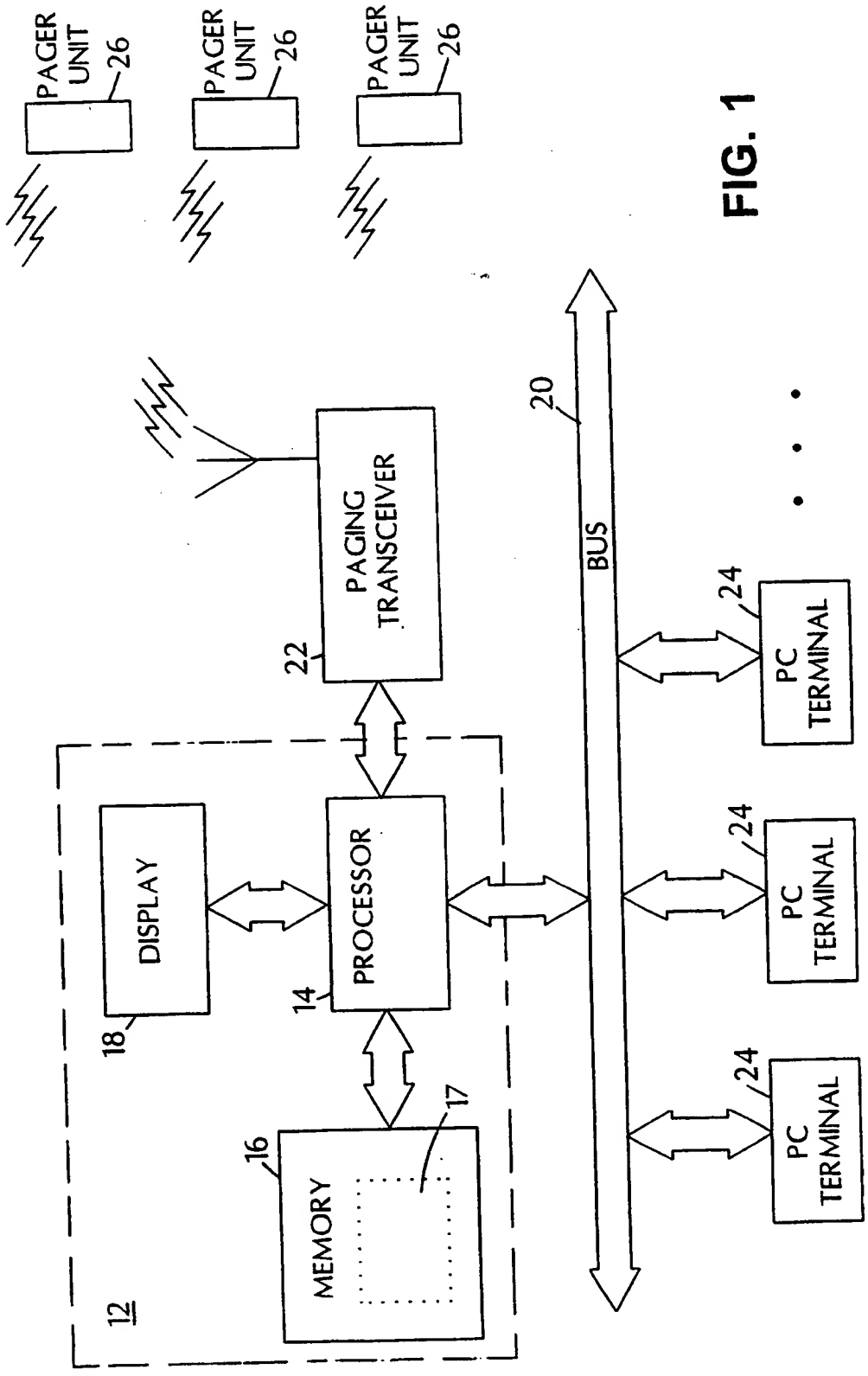

PAGER UNIT 26
PAGER UNIT 26
PAGER UNIT 26
PAGING TRANSCEIVER 22
BUS 20
PC TERMINAL 24
PC TERMINAL 24
PC TERMINAL 24
DISPLAY 18
PROCESSOR 14
MEMORY 16
17
12

FIG. 1

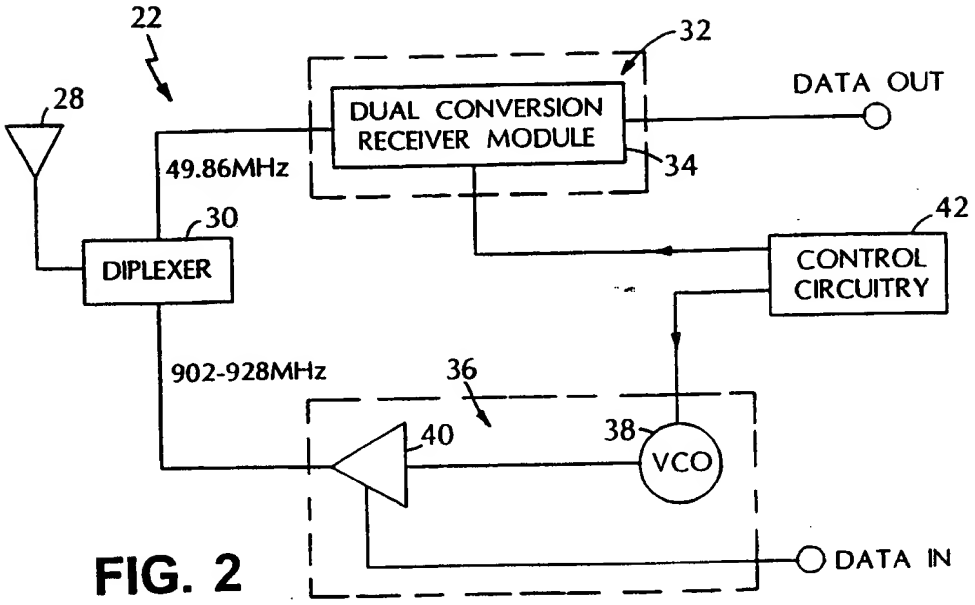

22
32
28
DUAL CONVERSION RECEIVER MODULE
DATA OUT
49.86MHz
34
30
42
DIPLEXER
CONTROL CIRCUITRY
902-928MHz
36
40
38
VCO
DATA IN

FIG. 2

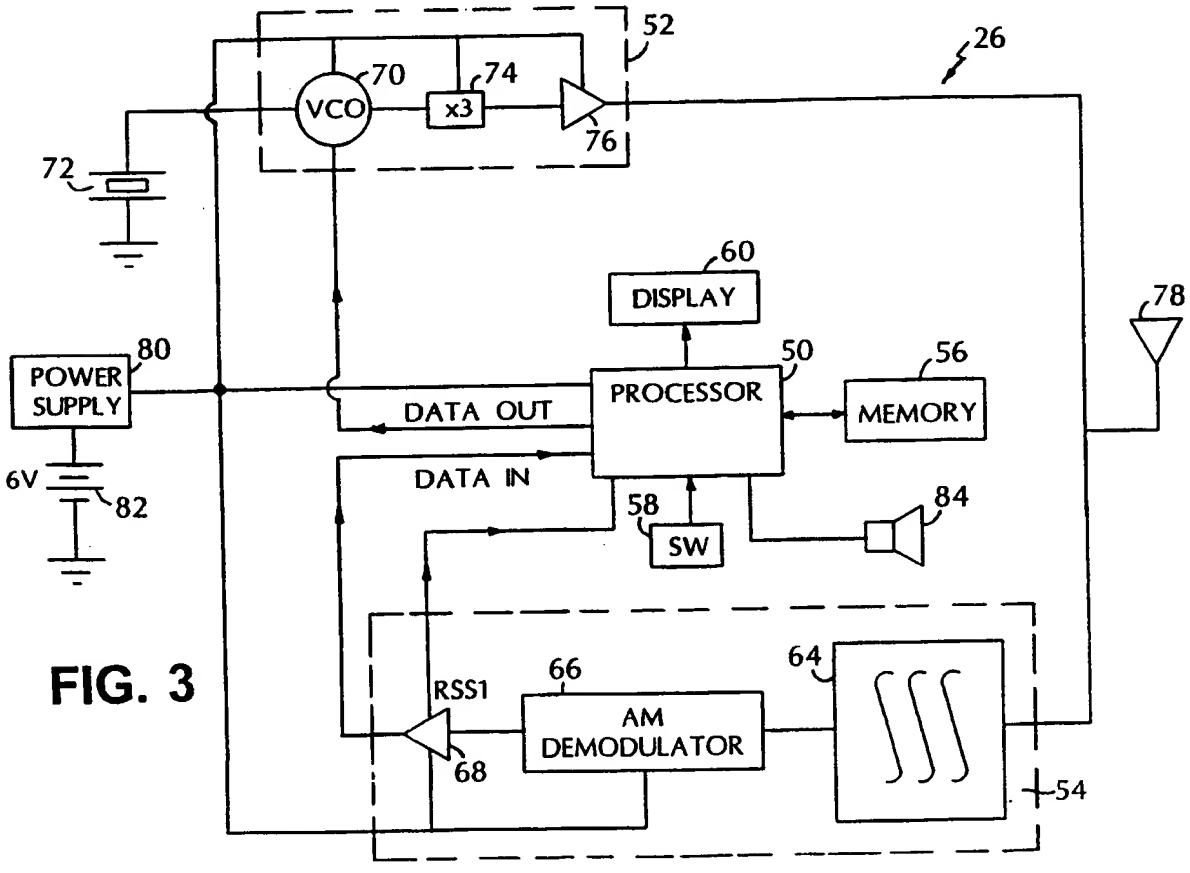

52
26
VCO
70
74
x3
76
72
60
DISPLAY
78
POWER SUPPLY
80
50
56
PROCESSOR
MEMORY
DATA OUT
6V
82
DATA IN
58
84
SW
RSS1
66
64
AM DEMODULATOR
68
54

FIG. 3

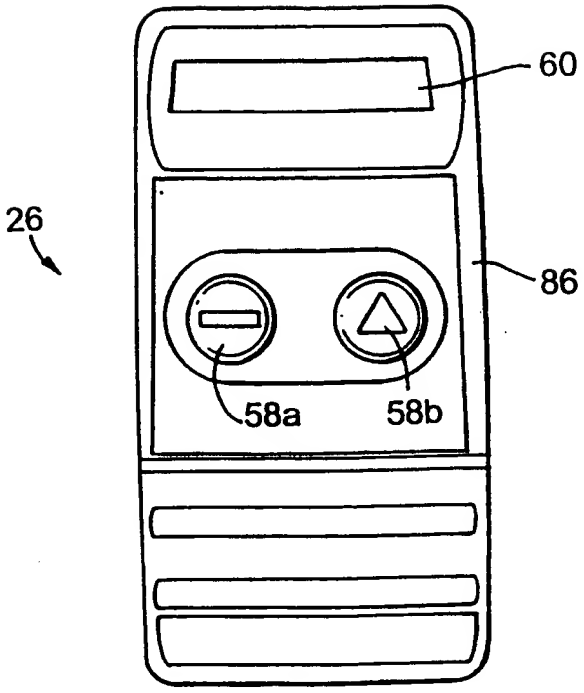
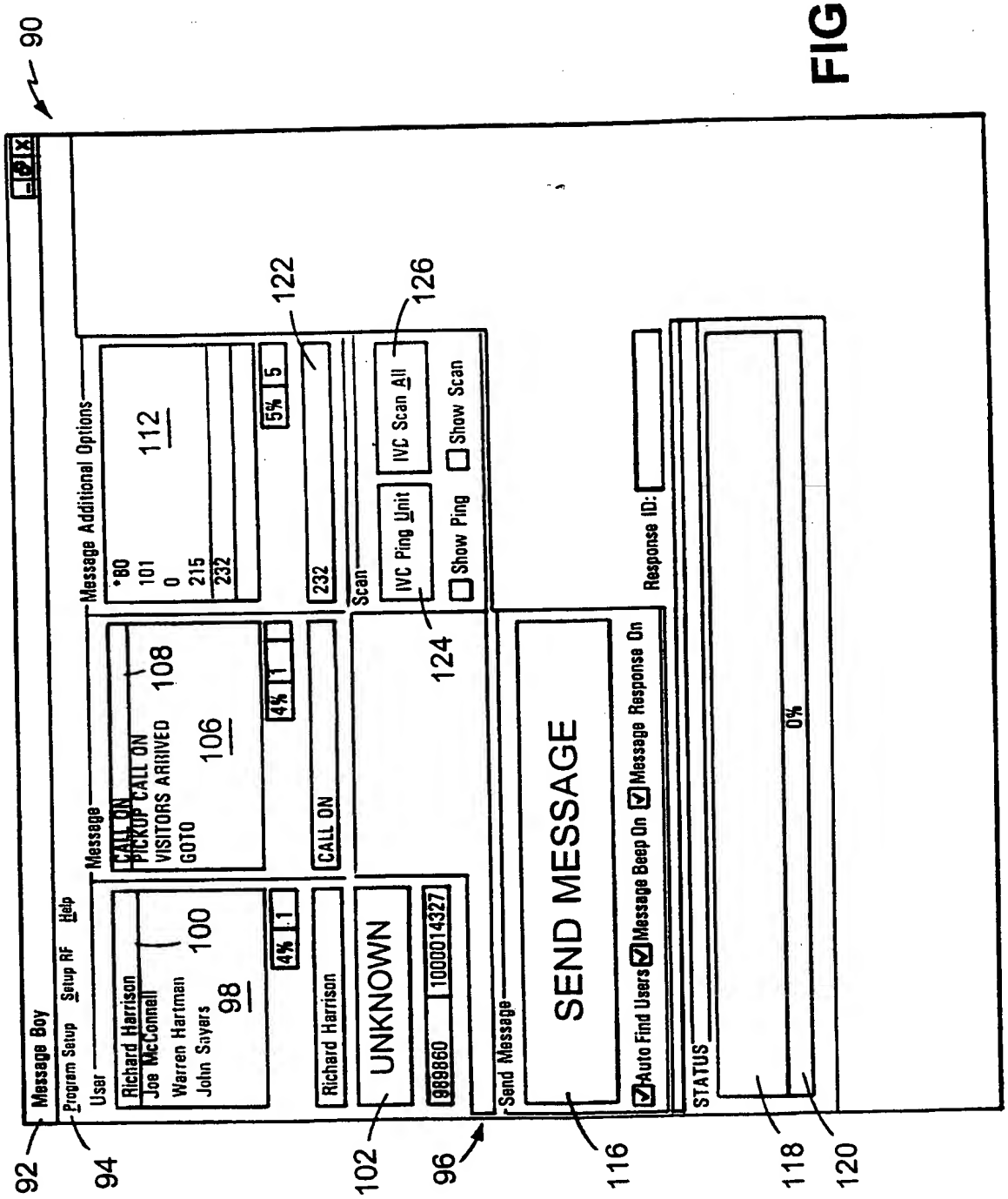


FIG. 4

FIG. 5


90
Message Boy
Program Setup Setup RF Help
User
Richard Harrison
Joe McConnell
Warren Hartman
John Sayers
100
98
4% 1
Message
CALL ON
PICKUP CALL ON
VISITORS ARRIVED
GOTO
108
106
4% 1
CALL ON
Richard Harrison
UNKNOWN
9898860
10000014327
102
96
Message Additional Options
*80
101
0
215
232
112
5% 5
122
232
Scan
IVC Ping Unit
Show Ping
IVC Scan All
Show Scan
126
124
Send Message
SEND MESSAGE
116
Response ID:
Auto Find Users
Message Beep On
Message Response On
STATUS
0%
118
120
92
94

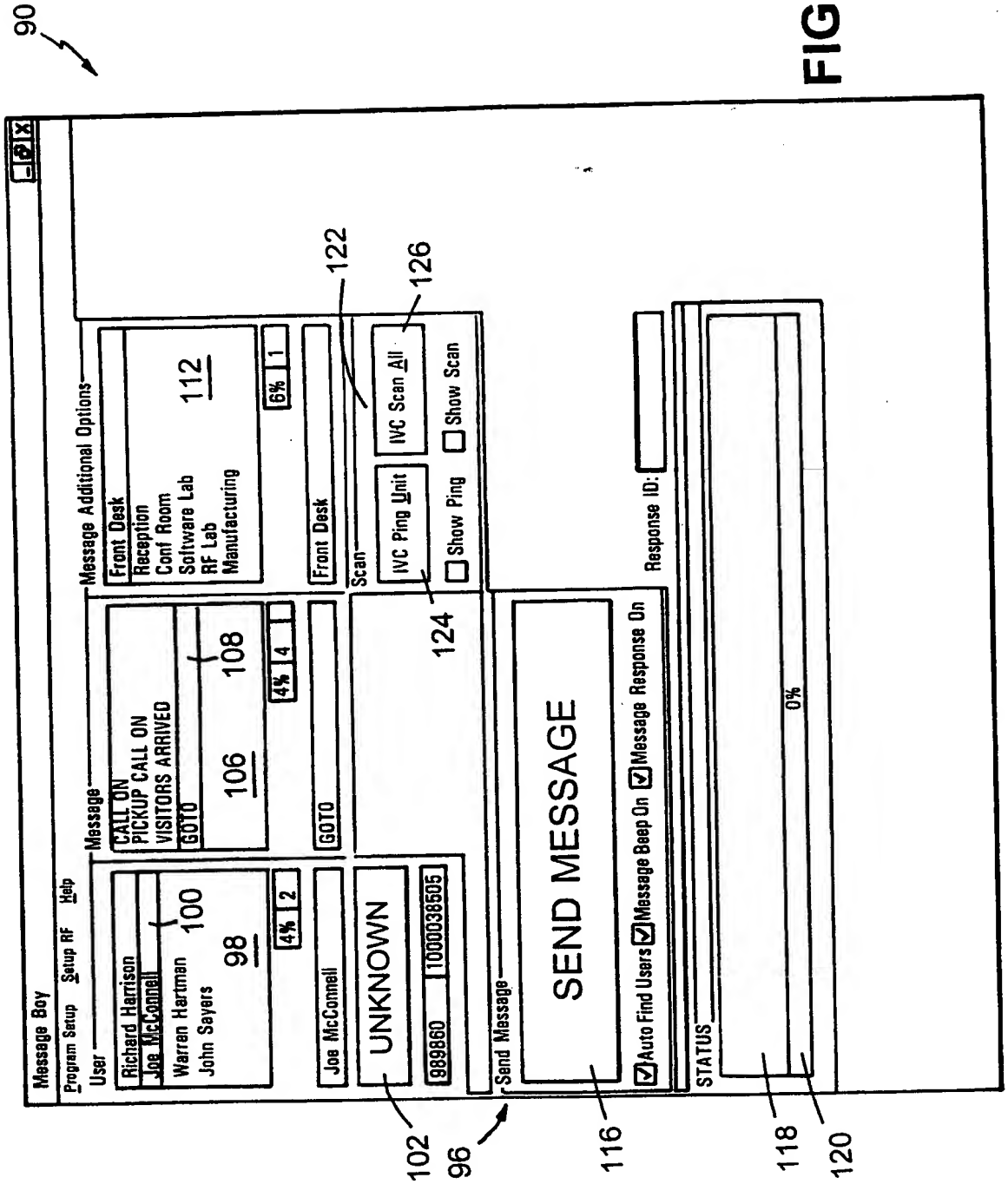

90
Message Boy
Program Setup
Setup RF
Help
User
Richard Harrison
Joe McConnell
Warren Hartman
John Sayers
100
98
4% 2
Message
CALL ON
PICKUP CALL ON
VISITORS ARRIVED
GOTO
106
108
4% 4
Joe McConnell
GOTO
UNKNOWN
989860
1000038505
102
Message Additional Options
Front Desk
Reception
Conf Room
Software Lab
RF Lab
Manufacturing
112
6% 1
Front Desk
122
Scan
IVC Ping Unit
IVC Scan All
126
Show Ping
Show Scan
124
Send Message
SEND MESSAGE
96
116
Auto Find Users
Message Beep On
Message Response On
Response ID:
STATUS
0%
118
120

FIG. 6

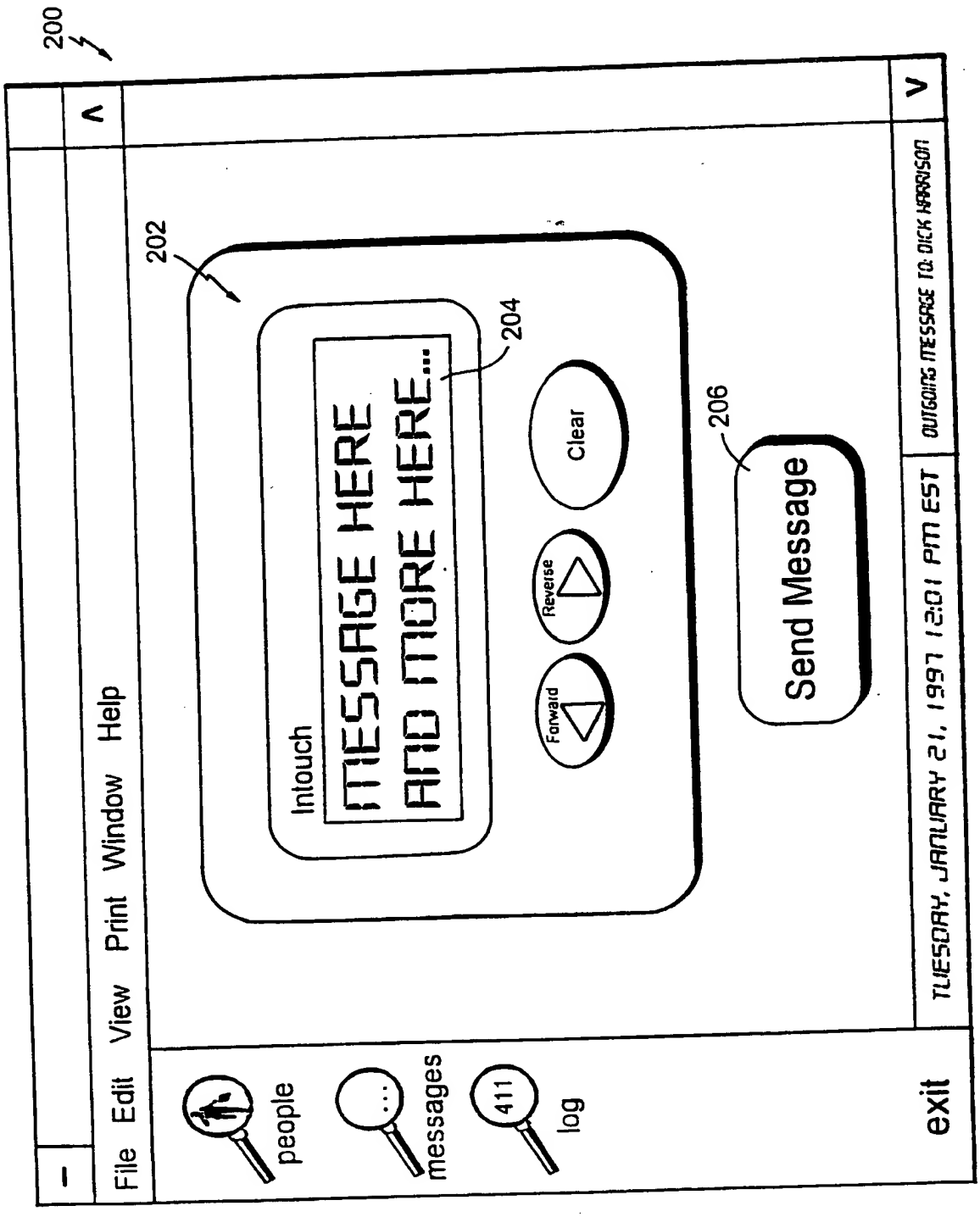

200
File Edit View Print Window Help
people
messages
log
exit
202
Intouch
MESSAGE HERE
AND MORE HERE...
204
Forward
Reverse
Clear
206
Send Message
TUESDAY, JANUARY 21, 1997 12:01 PM EST
OUTGOING MESSAGE TO: DICK HARRISON

FIG. 7

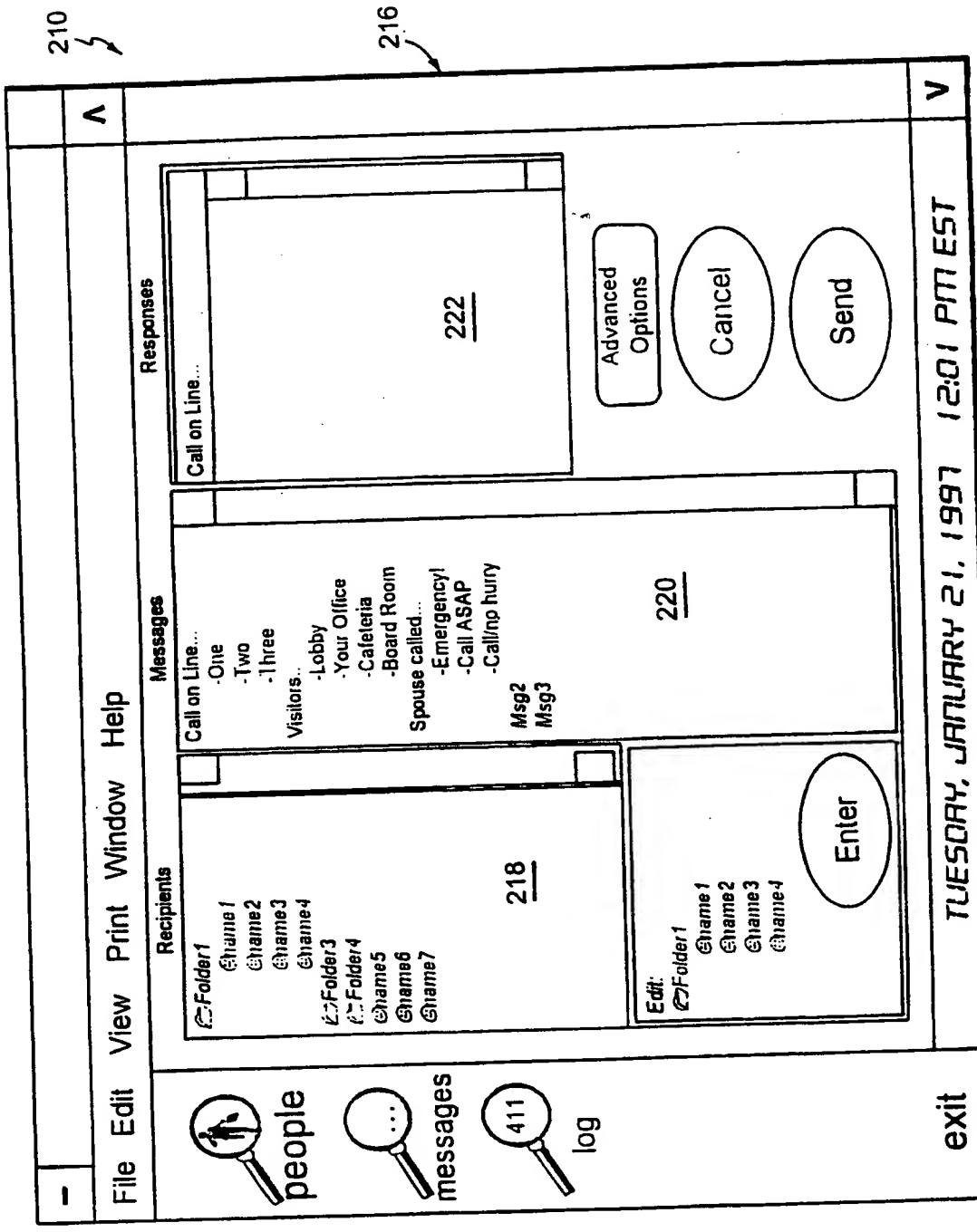

210
216
File Edit View Print Window Help
people
messages
log
exit
Recipients
Messages
Responses
Folder1
Name1
Name2
Name3
Name4
Folder3
Folder4
Name5
Name6
Name7
218
Call on Line...
-One
-Two
-Three
Visitors...
-Lobby
-Your Office
-Cafeteria
-Board Room
Spouse called...
-Emergency!
-Call ASAP
-Call/no hurry
Msg2
Msg3
220
Call on Line...
222
Edit:
Folder1
Name1
Name2
Name3
Name4
Enter
Advanced Options
Cancel
Send
TUESDAY, JANUARY 21, 1997 12:01 PM EST

FIG. 8

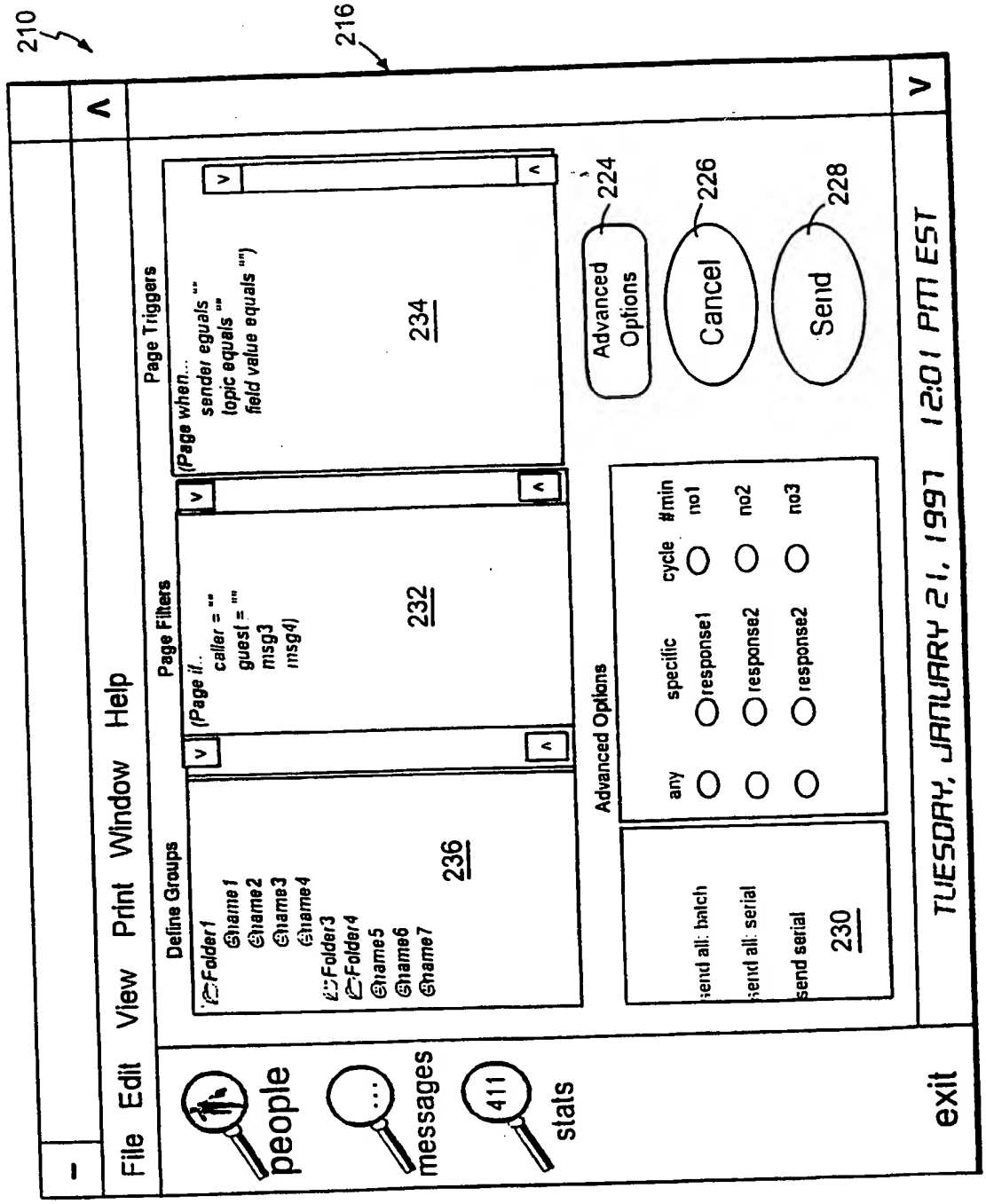

210
216
File Edit View Print Window Help
people
messages
stats
exit
Define Groups
Folder1
Name1
Name2
Name3
Name4
Folder3
Folder4
Name5
Name6
Name7
236
Page Filters
(Page if...
caller = ""
guest = ""
msg3
msg4)
232
Page Triggers
(Page when...
sender equals ""
topic equals ""
field value equals "")
234
Advanced Options
224
Cancel
226
Send
228
Advanced Options
any
specific
cycle
#min
response1
response2
response2
no1
no2
no3
send all: batch
send all: serial
send serial
230
TUESDAY, JANUARY 21, 1997 12:01 PM EST

FIG. 9

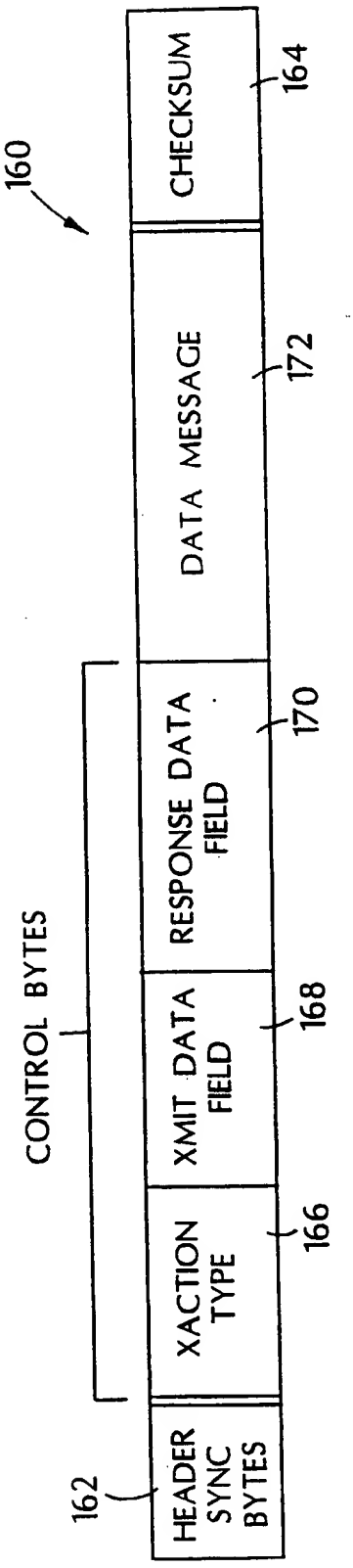

160
CHECKSUM
164
DATA MESSAGE
172
RESPONSE DATA FIELD
170
XMIT DATA FIELD
168
XACTION TYPE
166
CONTROL BYTES
HEADER SYNC BYTES
162

FIG. 10

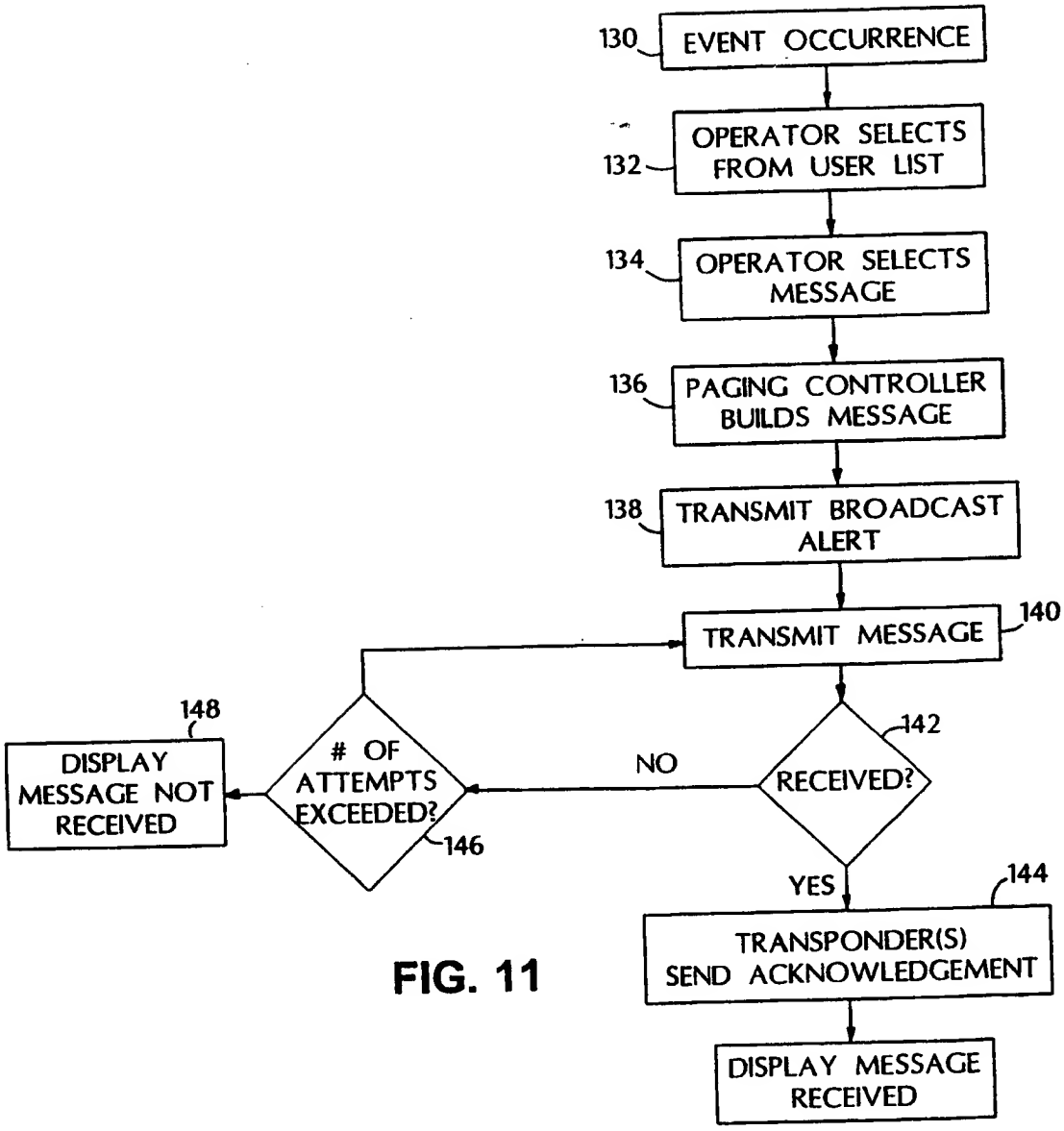

130
EVENT OCCURRENCE
OPERATOR SELECTS FROM USER LIST
132
134
OPERATOR SELECTS MESSAGE
136
PAGING CONTROLLER BUILDS MESSAGE
138
TRANSMIT BROADCAST ALERT
TRANSMIT MESSAGE
140
142
RECEIVED?
NO
OF ATTEMPTS EXCEEDED?
146
148
DISPLAY MESSAGE NOT RECEIVED
YES
144
TRANSPONDER(S) SEND ACKNOWLEDGEMENT
DISPLAY MESSAGE RECEIVED

FIG. 11

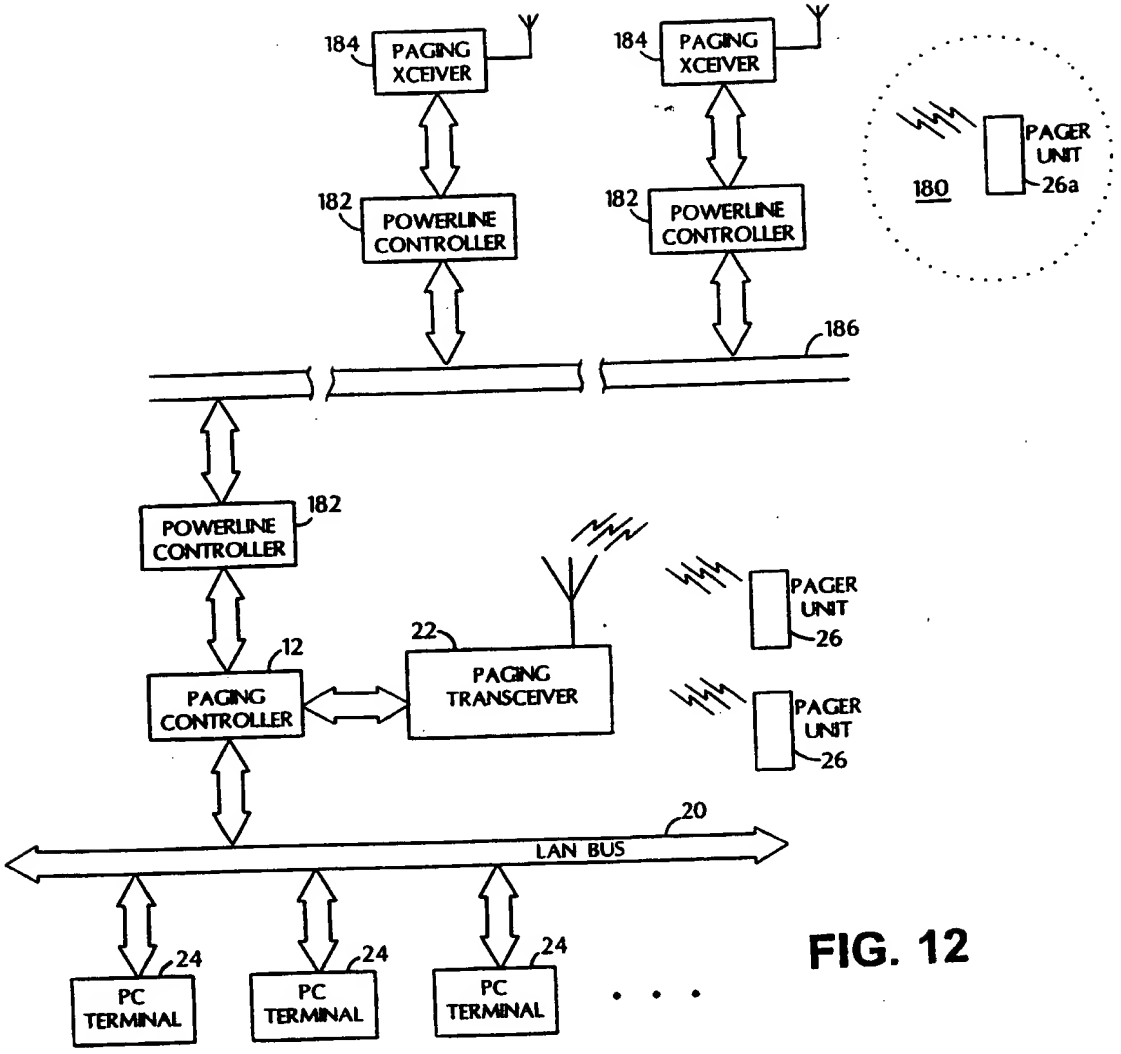

184
PAGING XCEIVER
184
PAGING XCEIVER
PAGER UNIT
26a
180
182
POWERLINE CONTROLLER
182
POWERLINE CONTROLLER
186
POWERLINE CONTROLLER
182
PAGER UNIT
26
22
PAGING TRANSCEIVER
12
PAGING CONTROLLER
PAGER UNIT
26
20
LAN BUS
24
PC TERMINAL
24
PC TERMINAL
24
PC TERMINAL

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/18404

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G08B 5/22; H04J 3/24
US CL : 340/825.44; 455/426, 556
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/825.44; 455/426, 556, 458, 466, 557, 31.2, 31.3, 38.2, 38.4

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NOKIA 2190 OWNER'S MANUAL

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,479,408 A (WILL) 26 DECEMBER 1995, COL 5, LINES 14-35, COL 8, LINE 44- COL 9 LINE 40, COL 10 LINES 25-57, COL 26 LINE 52- COL 28 LINE 45.	1-45
Y	US 5,487,100 A (KANE) 23 JANUARY 1996, COL 2 LINE 58- COL 3 LINE 12, COL 4 LINE 64- COL 5 LINE 6.	1-45
Y	NOKIA 2190 OWNER'S MANUAL, PAGE 46, LINES 14-35.	30-31
A	US 5,117,449 A (METROKA ET AL.) 26 MAY 1992, ABSTRACT.	1
A	US 4,940,963 A (GUTMAN ET AL.) 10 JUNE 1990, ABSTRACT.	1

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 17 DECEMBER 1998	Date of mailing of the international search report 25 FEB 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3991	Authorized officer EDWIN HOLLOWAY Joni Hill Telephone No. (703) 305-4818

Form PCT/ISA/210 (second sheet)(July 1992)*